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(54) GEL-IMPREGNATED SPONGES

(71) We, HAROLD S. AKRONGOLD, and ROCHELLE AKRONGOLD, both citizens of the United States of America, and both of 39 Cathay Road, East Rockaway, Long Island, New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a shaped article comprising a gel-impregnated sponge.

According to one aspect of the invention, there is provided a shaped article comprising a sponge body of polyether-polyurethane foam which is either fully reticulated (as herein defined) with a porosity of at least 70 pores per square inch or partially reticulated (as herein defined) with a porosity of at least 30 pores per square inch, the sponge body having at least two layers of which at least one is impregnated with a solidified gel material and of which at least one other layer is, in the dry state, substantially free from such gel impregnant.

Thus, the sponge body has, in effect, at least two layers of which at least one gel-impregnated and at least one other is substantially free from gel-impregnant in the dry state.

Depending on the nature of the gel material, the articles of the invention may have a variety of different purposes. Thus, it may take the form of a sponge for cleaning purposes, a room deodoriser, a cosmetics dispenser, an air filter, a cigarette filter, or a toy ball.

A particular embodiment of the invention comprises a moulded or shaped body which, preferably but not necessarily, has curved or rounded corners, and which is partially impregnated by a solidified gel having detergent or washing properties. The term "detergent or washing properties" includes both certain synthetic detergents and also natural washing agents such as soap.

In this moulded or shaped body, the sponge which is used is either partially or fully reticulated. The term "fully reticulated" means that it contains pores or channels at least 99.1% of which are completely open throughout their lengths. The term "partially reticulated" means that more than 0.9% of the pores are closed or blocked by membranes extending across them. Generally, the fully reticulated sponge should have between about 70 and about 200 pores per square inch (ppi) while the partially reticulated sponge should have between about 30 and about 200 ppi. The upper limit of 200 is not critical but is used because it is difficult to make a sponge with greater porosity. However, the lower limit is important for the reasons to be hereinafter explained.

According to a further aspect of the invention, a method of making a shaped article comprises the steps of inserting a gel-forming material into a mould at a temperature at which said material is in the liquid state, immersing a portion of a sponge in the gel-forming material in the mould while said material is still in the liquid state, removing the immersed portion which has been impregnated with the material during the immersion, from the mould before solidification of said material has been completed, inverting the impregnated sponge, while maintaining said sponge free from compressive pressure, to permit the material, while still in its liquid state, to migrate inwardly from the surface of the previously-immersed portion of the sponge, and then allowing the impregnated sponge to cool to complete solidification of said material.

In making the product, the gel material is initially in a heated liquified state and, while in such liquid state, is poured into a mould which may be of dish-like or any other desired shape. The sponge is then pressed into the liquid from the open top of the mould until the bottom of the sponge is in contact with the bottom of the mould, at which position the upper portion of the sponge extends above the mould.

The liquid, which is no longer subject of heat, begins to harden in the mould. However, before the final surface solidification of the gel, the sponge is removed from the mould and inverted.

This is a highly important step because in such manner, the liquid migrates from the surface of the portion of the sponge to the interior of the sponge, and final surface gelation takes place outside the mould and this forms a fibrous or fur-like coating on the bottom and side surfaces of the article at those areas which were initially immersed in the liquid. Ordinarily, if the liquid is allowed to harden completely within the mould before the article is removed, these surfaces are tacky and waxy to the touch, making them difficult or at least annoying to handle. When using the present process, the fibrous or furry surface covers the exposed surfaces and makes them non-tacky and easy to handle.

It is necessary to obtain a layered construction whereby a portion of the sponge is free from solidified gel. This is most important when the article is used for washing purposes such as cleaning the skin or as a substitute for the ordinary sponge and soap in the bath because, when wet, the soft, unimpregnated sponge layer acts in the same manner as an ordinary sponge while the gel in its lower portion is dissolved by the water and flows through the sponge to the skin. The gel-impregnated sponge, therefore, acts both as a sponge and as a bar of soap or detergent.

In order to keep the upper portion of the to prevent the gel, while in its liquid state, article free of hardened gel, it is necessary from flowing through the pores of the upper portion of the sponge and permeating it. It is for this reason that the above-noted ranges of porosity are important. In a "fully reticulated" sponge (i.e. where the pores are about 99.1—100% free from blocking membranes), where the sponge contains at least about 70 ppi, the pores are so small that as the heated liquid flows through, there is a substantially large amount of sponge surface area available to absorb the heat, whereby the liquid cools quickly. Furthermore, the air passing down through the open tops of the large number of pores also acts to cool the liquid passing up. As a result, the liquid gels quickly and is set in place long before it has an opportunity to permeate up into the upper portion of the sponge.

When using partially reticulated sponge material, the ppi may be as low as about 30 because in such material, the membrane-covered pores act to block the upward passage of the liquid. This, plus the cooling effect of the open pores described above, prevents permeation of the upper sponge layer.

It is also possible effectively to utilize a fully reticulated sponge with a ppi as low as about 40 if an additional step is used. This additional step consists of using a mould having apertures therein through which jets of air or similar gas is blown. This air acts both as a counterforce to the flow of the liquid and as a coolant to aid in its rapid gelation. It is also possible to utilize sponges of lower porosity if the gel point of the liquid is controlled by the addition of additives or the like, but this is less preferable because such additives could affect the purity of the gel.

If a plurality, such as three layers, are desired, the article formed in the above manner can then be inverted in the mould so that the liquid migrates from the surface of the previously immersed portion to the interior of the sponge, with the result that the originally gel-free sponge portion is now partially impregnated with a gel. In this manner, an article is produced having top and bottom gel-impregnated portions and a central layer free of gel. This process may be used to obtain an article having three different colours, as for example, a red pigmented gel can be used for the first gelation step and a blue pigmented gel can be used for the second gelation step so that if the sponge itself is white, a red, white and blue article is produced. Such article does not have the soft sponge-like quality at one side but is still useful as a washing or cleaning bar.

For use in the method of the invention, the sponge material may, for example, comprise polyester and polyether polyurethane foams, polyolefin foams such as polypropylene and polyethylene foams, latex and natural rubber foams, silicate foams, ceramic foams and cellulose sponges.

The preferred sponge material used in the method of the invention comprises polyurethane foams of the polyether type, as such foams are stable to surfactants such as soap and synthetic detergents. These foams are standard materials available on the open market and need not, therefore, be described in any further detail here since, by themselves, they form no part of the present invention.

The gel material may be any material that is liquid in one state, such as when heated, and then gels and hardens in a second state, as when cooled. Such materials, include soap gels, detergent gels, polymer gels, and thermoplastics. The basic requirements is that they be liquid and capable of pouring below the melting or deterioration point of the sponge material being used. These gel materials are also standard materials which need not be described in detail herein because they, too, are generally standard and available on the open market, and therefore, by themselves, form no part of the present invention.

Referring now more particularly to the accompanying drawings, there is shown in Fig. 1 a perspective view of a shaped washing bar, generally designated 10, having an upper layer 12 of soft sponge material which is unimpregnated, and a lower layer 14 which is the same sponge material but impregnated with a detergent gel that has hardened in situ in a mould. The upper and peripheral surfaces

16 of the layer 12, have a fibrous or furry texture.

Fig. 2 is a perspective view of a shaped body, generally designated 20, similar to that shown in Fig. 1 except that it has been made by first impregnating one end and then inverting it in the mould and impregnating the other end. An upper layer 22 is coloured blue, a centre layer 24 is the original white sponge, and a lower layer 26 is coloured red.

Fig. 3 is a somewhat schematic, greatly enlarged, cross-sectional view of a portion of a reticulated sponge material, generally designated 30, showing open ports as at 32.

Fig. 4 is a view, similar to Fig. 3, which shows a partially reticulated sponge material, generally designated 40, having open pores 42 and also pores 44 which are closed by membranes stretched across them. Actually, there may be far fewer closed pores than shown in Fig. 4, but this figure is provided merely to illustrate the general concept of closed and open pores.

An example of a partially reticulated polyether type polyurethane foam which can be used as the sponge material is the so-called "Nerf" foam (Okenel Corp., Lyndhurst, New Jersey), while an example of a fully reticulated polyether type polyurethane foam is "Scot Foam" (Scott Paper Co., Chester, Pa.). The "Nerf" foam has a ppi of about 50—60, while the "Scott Foam" has a ppi of about 70—120 ppi.

The following examples are ilustrative of the present invention:

Example 1

A formulation of the gel material was made with the following components:

Components	Per cent by wt.
"Miranol acid (C2M)" (an imidazoline surfactant, a product of Minanol Chemical Co.)	12.0
ricinoleic acid	12.0
diethanolamine	30.0
sodium stearate	26.0
sodium lauryl sulphate (powder)	10.0
"Shercomid CDO" (diethanolamide of mixed fatty acids—Sher Bros., Clifton, N.J.)	10.0

The two acids were mixed together with the diethanol amine to 110°C with agitation. While maintaining the agitation and the temperature at 110°C, the sodium stearate was added, and then the remainder of the components were added at the same temperature and while under agitation.

The resulting liquid was poured into a mould and a sponge formed of "Scott Foam" (100 ppi) was inserted into the liquid in the mould with the upper portion of the sponge extending upwardly from the mould. The impregnated sponge was then removed from the mould before the liquid was completely solidified, after which solidification took place outside the mould. The resulting sponge had fur-like, non-waxy outer surfaces where the sponge had originally been impregnated, by virtue of the subsequent migration of the liquid away from these surfaces, and the unimpregnated portion retained its original soft texture.

The same liquid composition was used in the same type of mould and in the same manner to impregnate (a) "Nerf" foam, and (b) a cellulose sponge, both of which were partially reticulated, the "Nerf" foam having a ppi of 50 while the cellulose sponge had a ppi of 30.

Example 2

Components	Percent by wt.
diethanolamine	25.0
ricinoleic acid	12.0
sodium stearate	25.0
"Maprofix TLS-65" (triethanolamine lauryl sulfate-Onyx Chem. Co., Jersey City, N.J.)	23.0
"Shercomid CDO"	15.0

The diethanolamine and the ricinoleic acid were heated together at 95°C with agitation. The sodium stearate was then slowly added, while maintaining the temperature at 95°C. Then, at the same temperature and while maintaining the agitation, the remaining components were added. The resultant liquid, which was red in colour, was then poured into a mould, while still at 95°C, and a "Scott Foam" sponge, having a ppi of 100, was inserted and then removed prior to complete hardening of the gel in the same manner as in Example 1.

The same types of "Nerf" foam and cellulose sponge as in Example 1 were treated in the same manner.

Example 3

A gel material was formed with the following components:

Components	Per cent by wt.
"Unimide JJ72-3" (polyimide-Lonza, Inc., Fair Lawn, N.J.)	30.0
"Miranol acid (C2M)"	1.0
isostearic acid	5.0
"Emerez 1535" (Reg. Trade Mark for polymerized fatty acid polyamide-Emery Industries, Inc., Cincinnati, Ohio)	25.0
"Standopol 7021 Conc." (mixture of di- and triethanolamine lauryl sulfate—Henkel Chem. Co.)	30.0

All the components except the "Standopol" were heated to 140°C under agitation, after which the "Standopol" was added with agitation.

The same type sponges and treatments were used as in Example 1 with the same results.

Example 4

A gel material was made with the following compositions:—

Components	Per cent by wt.
"Shercomid CDO"	20.0
"Unirez 2930" (polyamide—Union Camp Corp.)	18.0
"Standopol 7021 Conc.	54.0
"Polectron 450" (N-vinyl-carbazole polymer—GAF, New York, N.Y.)	8.0

The "Shercomid" was heated to 135°C, at which time the "Unirez" was added. The temperature was then lowered to 90°C and at this temperature, the "Standopol" was added. The temperature was then lowered to 75°C at which time the "Polectron" was added and the liquid turned white.

The same type of sponge materials as in Example 1, were treated in the same manner.

WHAT WE CLAIM IS:—

1. A shaped article comprising a sponge body of polyether-polyurethane foam which is either fully reticulated (as herein defined) with a porosity of at least 70 pores per square inch or partially reticulated (as herein defined) with a porosity of at least 30 pores per square inch, the sponge body having at least two layers of which at least one is impregnated with a solidified gel material and of which at least one other layer is, in the dry state, substantially free from such gel impregnant.

2. An article according to Claim 1, wherein the gel material is soap and/or a synthetic detergent.

3. A shaped article having a unitary sponge body, substantially as hereinbefore described with reference to the accompanying drawings.

4. A method of making a shaped article which comprises the steps of inserting a gel-forming material into a mould at a temperature at which said material is in the liquid state, immersing a portion of a sponge in the gel-forming material into the mould while said material is still in the liquid state, removing the immersed portion, which has been impregnated with the material during the immersion, from the mould before solidification of said material has been completed, inverting the impregnated sponge, while maintaining said sponge free from compressive pressure, to permit the material, while still in its liquid state, to migrate inwardly from the surface of the previously-immersed portion of the sponge, and then allowing the impregnated sponge to cool to complete solidification of said material.

5. A method according to Claim 4, wherein the sponge is fully reticulated.

6. A method according to Claim 4, wherein the sponge is partially reticulated.

7. A method according to Claim 4, wherein the sponge has at least 30 pores per square inch.

8. A method according to any one of Claims 4 to 7, wherein the sponge is a polyether-polyurethane foam.

9. A method of making a shaped article substantially as hereinbefore described.

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FIG. 1.

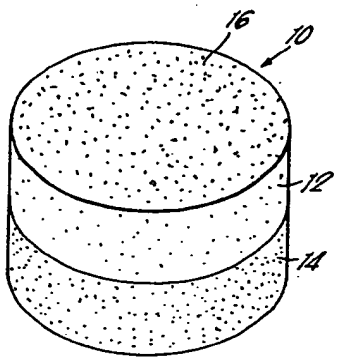

FIG. 2.

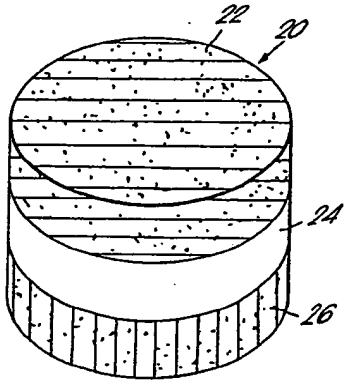

FIG. 3.

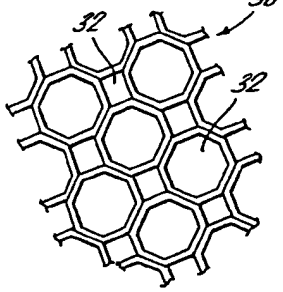

FIG. 4.